DOCUMENT RESUME

ED 373 078 TM 021 818

AUTHOR	McMillan, Douglas N.; Walters, Elizabeth
TITLE	The Use of Visuoconstructive Tasks in the Assessment of Attention Deficits: Towards a Standard Assessment Battery.
PUB DATE	Aug 92
NOTE	27p.; Paper presented at the Annual Meeting of the American Psychological Association (100th, Washington, DC, August 1992).
PUB TYPE	Reports - Research/Technical (143) -- Speeches/Conference Papers (150)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Age Differences; *Attention Deficit Disorders; Correlation; Educational Assessment; *Hyperactivity; Regression (Statistics); *Standardized Tests; Student Evaluation; *Test Construction; Test Use; Test Validity
IDENTIFIERS	Benton Visual Retention Test; Cognitive Control Battery; Peabody Picture Vocabulary Test; *Visuoconstructive Tasks

ABSTRACT

Findings from a multiphase project to develop a standard assessment battery for Attention Deficit Hyperactivity Disorder (ADHD) are reported. In the first study, validity of a delayed-recall administration of the Benton Revised Visual Retention Test (Benton, 1974) was examined with 30 children individually given 3 administrations of the Benton while their teachers completed the Conners' Teacher Ratings Scale-39 (CTRS-39) (Conners, 1991) for each student. A stepwise multiple regression indicated that the two variables contributing significantly were the age of the subject and the Benton-D variable. In the second study, the Peabody Picture Vocabulary Test-Revised (PPVT-R) (Dunn and Dunn, 1981) and the Cognitive Control Battery (CCB) (Santosefano, 1988) were given along with the Benton to 34 subjects. Two stepwise multiple regressions indicate that PPVT-R T-score, Benton C and D correct-scores, and two variables from the CCB contribute significantly to the regression equation. The third regression replaced the CTRS-39 with the Attention Deficit Hyperactivity Disorder Evaluation Scale as the dependent variable. Results across both studies indicate that both the Benton and the CCB are significant predictors of teacher ratings of ADHD. implications for the development of a standard battery for the assessment of ADHD are discussed and suggestions are made for future research. (Contains 16 references and 5 tables.)
(Author/SLD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 373 078

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL IN OTHER THAN PAPER COPY HAS BEEN GRANTED BY

DOUGLAS N. MCMILLAN

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)"

The Use of Visuoconstructive Tasks in the Assessment of Attention Deficits: Towards a Standard Assessment Battery

Douglas N. McMillan and Elizabeth Walters

Southeastern Oklahoma State University

Presented at the 100th Annual Convention of the American Psychological Association

Washington, D.C.

August 18, 1992

10:00 to 11:50 a.m.

Running Head: Attention Deficit

TM021818

BEST COPY AVAILABLE

Abstract

The purpose of this study was to investigate a process for diagnosing Attention Deficit Hyperactivity Disorder (ADHD) in children. Reported are the findings from the first two stages of a multiphase project designed to develop a standard assessment battery. In the first study, the validity of a delayed-recall administration of the Benton Revised Visual Retention Test (Benton, 1974) was examined. Thirty subjects from five school districts in southeastern Oklahoma were individually given three different administrations of the Benton, and their teachers completed the Conners' Teacher Ratings Scale-39 (CTRS-39; Conners, 1991) for each referred subject. A stepwise multiple regression indicated that the two variables contributing significantly to the regression equation were the age of the subject and the Benton-D variable. In the second study to determine if diagnostic prediction could be improved with a multiple measurement approach, the Peabody Picture Vocabulary Test-Revised (PPVT-R; Dunn & Dunn, 1981) and the Cognitive Control Battery (CCB; Santostefano, 1988) were given along with the Benton to 34 subjects recruited from a single school district. Two stepwise multiple regressions indicated that five variables contributed significantly to the regression equation: PPVT-R T-score, Benton C and D correct-scores; and two variables from the CCB Fruit Distraction Test. The third and last regression was the same as the previous ones except that the Attention Deficit Hyperactivity Disorder Evaluation Scale (McCarney, 1989) replaced the CTRS-39 as the dependent variable. The results across both studies indicate that both the Benton and the CCB are significant predictors of teacher ratings of ADHD. Implications for the development of a standard battery for the assessment of attention deficits are discussed and suggestions for future research are made.

The Use of Visuoconstructive Tasks in the Assessment of Attention Deficits: Towards a Standard Assessment Battery

Attention Deficit Disorder (ADD) is the most frequently encountered childhood behavioral disorder, affecting an estimated 10 to 20 percent of all school age children (Shaywitz & Shaywitz, 1991). As would be expected from the magnitude of the problem and the number of children affected, a mountainous volume of research has been generated on this topic. Yet, remaining are many very perplexing problems, particularly in the accurate classification and diagnosis of ADD. Fletcher, Morris, and Francis (1991) indicate that one of the most persistent problems encountered by researchers in this area is the symptom overlap between ADD and other childhood disorders such as anxiety, oppositional disorder, conduct disorder, and a related issue of how to differentiate between aggression and ADD. These authors rightfully indicate that underlying the difficulties of differential diagnosis are the broader problems of measurement, sampling, and classification of attention deficit disorders. More specifically, Fletcher, et al, state that ADHD research is hampered by arguments as to "(a) how the disorder is to be defined, (b) how it is related to other disorders, and (c) how relevant dimensions are to be measured" (p.72).

One of the most common methods used in clinical practice to assess attention deficits is the use of various behavior rating scales (Kerasotes & Walker, 1983), but the difficulties encountered in using these scales are well documented (Issacs & Michaels, 1983; Walen & Henker,1991). A persistant problem with any rating system is that the results are affected by the various response sets and rater biases, leaving professionals with the dilemma of trying to make sense out of ratings that may be biased and contradictory to other assessment data.

Walen and Henker correctly identify the underlying problem as a lack of agreement between the various observers of the child (i.e., teachers and parents) and a lack of consistency among the various assessment instruments. For other disorders, the most traditional psychometric solution to the problem has been the development of an instrument to meet all the following criteria: (1) independent administration by a diagnostician, (2) objective scoring procedures, (3) ease of incorporation within a standard psychoeducational battery, and (4) demonstrated validity. To date no instrument that meets these criteria for the diagnosis of attention deficits in children has been universally accepted.

A related principle frequently used to solve measurement problems, such as the biases found in ratings, is the principle of triangulation of measurement (Issacs and Michaels, 1983), which uses multiple assessment procedures to enhance accuracy in selection or diagnosis. From a phenomenological perspective, triangulation of data translates into taking a look at the data from more than one perspective. Taylor and Russell (1969) have demonstrated how dramatically the validity of the selection procedure is enhanced by the use of more than one assessment procedure, even when the additional procedures are of only modest validity. Ideally in practice, triangulation would lead to the development of a standard battery for the assessment of attention deficits in children and would include a variety of assessment procedures. This standard battery might include teacher rating scales, but it would also include a variety of other instruments to produce the highest validity for the entire decision making process. To date, very little research has taken this approach.

The research presented in this paper covers only the first two phases of an ongoing four-part project designed to identify and develop a standard battery for the assessment of

Attention Deficit Hyperactivity Disorder. The first phase was designed to investigate the possibility that a visuoconstructive task with a memory requirement, such as the Benton Visual Retention Test-administration A or D (Benton, 1974), could be used effectively in ADHD assessment. It was believed that the Benton tasks would closely approximate many of the academic tasks with which ADD children struggle and would therefore be useful in assessing attention deficits. More specifically, these tasks require the child to sustain attention and produce a modulated visual motor response from memory, a response that is difficult for ADD children to accomplish.

In the second phase, the Cognitive Control Battery (CCB; Santostefano, 1988) was used in conjunction with the Benton to determine if overall prediction could be improved. The CCB is based on Santostefano (1978) cognitive model of child development which states that there are certain mediating factors (cognitive controls) that affect children's abilities to learn and process information. Santostefano (1978) referred to these process variables as cognitive controls. According to Cotugna (1987), there are five specific cognitive controls which are measured in the Cognitive Control Battery, identified and defined as follows:

> ...(a) **body ego** and **tempo regulation**: the ability to experience, represent, and regulate one's body movements; (b) **focal attention**: the ability to scan, actively and broadly, increasing amounts of information in the environment; (c) **field articulation**: the ability to attend selectively only to designated, relevant information in the environment while ignoring irrelevant or distracting stimuli or information; (d) **leveling-sharpening**: the ability to construct stable and distortion-free memory images and to hold these memory images over time; and (e) **equivalence range**: the ability to

> group and categorize information in the environment into increasingly abstract and complex groupings (pp. 563-564).

As can be easily observed, a number of these cognitive controls would be logically and theoretically affected by the presence of an attention deficit hyperactivity disorder (ADHD). More specifically, the ADHD child's focal attention, field articulation, and leveling and sharpening would all theoretically be adversely influenced. These variables are measured in the CCB through a variety of scores and ratios on three separate tests which are the Scattered and Scanning Test, the Fruit Distraction Test, and the Leveling and Sharpening Test. Cotugna (1987) has studied the ability of the Cognitive Control Battery to discriminate between hyperactivity, learning disabilities, and controls. Cotugna found that the CCB did in fact effectively discriminate between these three groups. In addition, Cotugna found some distinct cognitive control differences between the three groups, but only the observations relevant to the hyperactivity will be summarized here.

First, Cotugna found that both the hyperactive children and nonhyperactive learning disabled children tended to scan a much more limited visual field than did the control children, and in addition, the hyperactive children tended to scan an even more narrow field than did the nonhyperactive learning disabled students. Second, the hyperactive subjects had greater difficulty in effectively using field articulation (selective attention) than the nonhyperactive learning disabled and the control children. Selective attention became more difficult for both the hyperactive and the nonhyperactive learning disabled subjects when they were required to hold in memory information concerning a complex stimulus, with the hyperactive subjects having greater difficulty than the nonhyperactive learning disabled subjects. In general,

hyperactive children were slower in naming the colors of fruit, more greatly affected by distractions, and slower to complete the entire test. Third, both the hyperactive and the nonhyperactive learning disabled children had significantly more difficulty regulating their motor tempo function than did the controls. Cotugna clearly demonstrated the utility of incorporating the Cognitive Control Battery into a standard battery approach for the assessment of ADHD. Based on Cotugna's results and on the clinical experience of the authors, it was proposed that the both the Fruit Distraction and the Leveling and Sharpening tests would assist in predicting teacher ratings of attention deficits.

Subjects

Thirty subjects were recruited from five school districts in southeastern Oklahoma. The superintendent of each school district was contacted by one of the principal researchers to obtain permission to recruit subjects from that district. All teachers in each of the districts received notices that gave them a brief explanation of the study and asked them to refer any student they suspected of having an attention deficit disorder. Along with this notice, the teachers received a detailed description of the symptoms associated with ADD. Initially, 15 students were referred as suspected of having attentional problems. After receiving a teacher referral, the graduate research assistants instructed the referring teacher to randomly select one additional student from the same classroom as each referred student. The randomization procedure was carefully monitored by the research assistants, and 15 additional students were selected to serve as controls and provide a broad range of subjects with various degrees of attentional capabilities. The research assistants contacted each selected child's parent or guardian to explain the purpose of the study and obtain a signed informed consent.

The sample was composed of 23 males and 7 females with the ethnic composition primarily Caucasian with one Native American child. The subjects ranged from 6 to 11 years (6 six-year-olds; 4 seven-year-olds; 2 eight-year-olds; 8 nine-year-olds; 6 ten-year-olds; and 4 eleven-year-olds), with a mean age of 8.533 and a standard deviation of 1.737.

Instruments

Benton Visual Retention Test-Revised (1974) Designed to test visuoconstructive ability by requiring the subject to draw three sets of designs (10 per set) which can be administered under four possible procedures. The objective scoring procedure includes an error score (coded by type of error) and a number-correct score. Each subject completes all three sets, each administered under a different procedure as specified by Benton (1974). The first procedure, administration C (Benton C), requires the subject to copy each design while viewing it. The second procedure, administration A (Benton A), requires the subject to view each design for 10 seconds and immediately reproduce it upon removal of the stimulus design, thus, introducing an element of immediate memory into the task. The third procedure, administration D (Benton D), requires the subject to view each design for 10 seconds, wait 15 seconds, and attempt to reproduce the design from memory. The Benton D, with a longer memory factor, was predicted to be the best indicator of attention deficits. The reader is referred to Benton (1974) for a complete discussion of the reliability and validity of this test, however, the reliability and validity were judged to be adequate. Each of the administrations of the Benton was scored by one of two expert diagnosticians who hold Ph.D.'s in psychology and special education. Samples of the Benton used in each study were scored by both scorers, and interrater reliability was estimated at 83.

Conner's Teacher Rating Scale-39. Designed to measure several different aspects of disruptive behavior in the classroom (Conners, 1990), the CTRS-39 consists of seven specific scales: (1) Hyperactivity Scale, (2) Conduct Problems Scale, (3) Emotionally-Indulgent Scale, (4) Anxious-Passive Scale, (5) Asocial Scale, (6) Daydreaming-Inattention Scale, and (7) Hyperactivity Index. The teacher rates the student on a four-point scale for each of the 39 items, and scores are converted to a t-score format. In both studies, only the Hyperactivity Scale was used as a criterion variable. The reader is referred to Conners (1990) for more detailed information.

Procedures

Each subject was administered each of the three design sets under a different procedure (C, A, and D) of the Benton (1974), and in addition, the teacher completed a CTRS-39 (Conners, 1990) on each referred child and on each control child. The results of each separate administration of the Benton were then correlated with the CTRS-39 Hyperactive Scale t-score, using a multiple regression procedure.

Results

A stepwise multiple regression (forward entry) was performed to analyze the data, using the SYSTAT (Wilkinson, 1990) statistical program. As suggested by Tabachnick and Fidell (1989), the basic procedure for testing the statistical assumptions of multiple regression was used to condition the data matrix, and when necessary in the second study, data transformations were used. The predictor variables in the regression equation were the error and number-correct scores from the Benton C, A, and D administrations and the subject's age, using raw scores rather than the deficit scale scores. The subject's age was included as a

predictor variable because of a high probability that it is a moderator variable in visuoconstructive performance (Benton, 1974). The dependent variable was the teacher's ratings on the CTRS-39, Scale A: Hyperactivity. The mean and standard deviations for the predictor variables are presented in Table 1, and the results of the multiple regression are presented in Table 2. Results of the stepwise multiple regression produced a Multiple R of .538 ($p < .01$, on the second and final step). The squared Multiple R was .290, and the adjusted squared multiple R was .237, indicating that the linear composite accounted for 23% of the shared variance in the teachers' ratings. Two steps were generated in the stepwise procedure, and the final subset model included the subject's age and the Benton-D error score (15 second delayed reproduction of design) as predictor variables.

Insert Table 1 and 2 about here

Discussion

The results of this study suggest the Benton Visual Retention Test (administration D) is potentially useful as an objective assessment of attention deficits in children. Inclusion of this type of instrument within a standard psychoeducational battery should help the examiner to make a more effective diagnosis of attentional capabilities of children and reduce the necessity of relying on behavior rating scales, freeing the diagnostician from trying to decipher the meaning of a rating scale, especially when the ratings may contradict other data sources. These conclusions should be viewed as only tentative since this is the initial investigation of this use of this instrument for assessment of attention deficits.

Experiment 2

Subjects

The sampling procedure in the second study was slightly different from the first study in that all 34 subjects selected from a single school district in southeastern Oklahoma. Seventeen of the referred subjects were suspected of having attention deficits and 17 additional students were selected to provide a broad range of attentional abilities. Other than the use of a single district for selection of subjects, all other aspects of the sampling and randomization procedures were identical to the first study.

The sample included 22 male and 12 female subjects with an ethnic composition of: 10 African Americans; 18 caucasian; and 6 Native Americans. Subjects' ages ranged from 7 to 12 years (2 seven-year-olds; 10 eight-year-olds; 9 nine-year-olds; 5 ten-year-olds; 6 eleven-year-olds; and 2 twelve-year-olds), mean age of 9.029 and standard deviation of 1.485.

Instruments

Two additional assessment instruments were added to the battery for study 2:

Cognitive Control Battery (CCB) This instrument is designed for use with children ranging in age from three to 16 years and consists of three sub-tests:

Scattered and Scanning Test Designed to measure the way in which an individual surveys a visual field by requiring the subject to locate and place a pencil mark on target symbols in a mixed field. The type of symbols and the complexity of the task vary according to the age of the subject.

Fruit Distraction Test Designed to measure field articulation or selective attention. The subject is required to perform several color naming tasks that vary in the degree

of complexity and level of distraction involved across four cards, all of which have exactly the same color-order for items. On the first card, the subject names several colored rectangles as quickly as possible with no distractors present. The second card requires the subject to name the colors of four kinds of correctly colored fruit. On card three, the subject is again asked to name the fruit colors, but various achromatic distractors (designs) surround the fruit. The final card displays the fruit in the same order as on cards two and three, but each fruit is colored incorrectly. The subject is asked to name the color that the fruit should be rather than the color shown.

Leveling and Sharpening Test Measures how an individual constructs memory images and compares them with subsequent perceptions. The subject is instructed to examine each of 60 line-drawings of a scene for 15 seconds and to inform the examiner when a change occurs in the stimulus (i.e., the removal of a sidewalk or part of a fence). A number of derived scores are figured for each section of the CCB, including t-scores, percentiles, and a variety of ratio scores.

The reader is referred to the test manual for an extensive discussion of the reliability and validity of the CCB (Santostefano, 1988).

Attention Deficit Disorders Evaluation Scale The ADDES consists of 60 items which are rated on a 0 to 4 scale. The school version is designed to assess the degree to which a student exhibits behaviors that meet the DSM-IIIR criterion for a diagnosis of ADHD. Adequate internal consistency, test-retest, and inter-rater reliability are reported in the manual (McCarney, 1989). Also reported in the manual are adequate content validity, criterion related validity, and construct validity. The reader is referred to the test manual for specific statistical

information. A factor analysis procedure was used to develop three specific sub-scales for the instrument: the Inattentive Scale, the Impulsive Scale, and the Hyperactive Scale. Raw data can be converted to a percentile or to a standard score with a range of 1 to 20, a mean of 10, and a standard deviation of 3.

Procedures

After the sample selection process was finished, all students completed the Peabody Picture Vocabulary Test Revised (1981), three administrations (B,C, and D) of the Benton Visual Retention Test (Benton, 1974), and all three sub-tests of the Cognitive Control Battery (Santostefano, 1988). In addition to the Conner's Teacher Rating Scale-39, the referring teacher was asked to complete the Attention Deficit Disorders Evaluation Scale-School Version (ADDES; McCarney, 1989) to provide another criterion variable to check the validity of the diagnostic battery. It was believed that if both the ADDES and the CTRS-39 demonstrated a similar relationship with the composite predictor variables, more confidence could be placed in the battery. The PPVT-R was added in an attempt to measure the possible contributing factor of intelligence.

The battery of tests was administered by a team of three to four graduate research assistants who received intensive training in the administration of the test battery. The researchers conducted several training sessions which included practice with children until the examiners reached a satisfactory level of competence. In addition, one graduate research assistant was trained to oversee the operation of the team in the field and to insure that data collection proceeded in an orderly, systematic manner. The team conducted testing sessions in the school on four separate dates. Portable testing stations equiped with privacy screens were

used so that more than one child could be tested at a given time, and each child's immediate environment would be free from extraneous distractions. Testing stations were set up in unused classrooms to minimize interference, and students were escorted from one station to the next as they completed each series of subtests.

One change made in the administration of the Benton was the substitution of administration B for administration A used in the first study. In administration B, the stimulus is exposed to the subject for 5 seconds, then covered, and the subject is asked to reproduce the design immediately. This change was made to determine if the length of exposure to the stimulus produced any significant difference when the time was shortened. Since there are only three parallel forms of the Benton, administration A (10 second exposure) was dropped from this study, but administrations C and D were retained.

Results

The collected data were analyzed by using two stepwise multiple regressions. The data matrix was checked for outliers, normality, homoscedasticity, et cetera, using the procedures recommended in Tabachnick and Fidell (1989). Some data transformations to this matrix were required in order to adequately meet the assumptions of the statistical test. A square root transformation was applied to the Benton-C error-score to correct for a positive skewness, and a reflective and square root transformation was applied to the Benton-C correct-score to adjust for a negative skew. All transformations were carried out according to the recommendations of Tabachnick and Fidell. The first stepwise multiple regression, using the CTRS-39 Hyperactivity Scale as the dependent variable, yielded a Multiple R of .774 with a squared multiple R of .599 and an adjusted multiple R of .527 ($p < .0001$). This analysis

indicates that almost 60 percent of the variance in the teacher's ratings was accounted for by the battery. The means and standard deviations are presented in Table 3 for all variables, and the results of the stepwise multiple regression are presented in Table 4.

Insert Table 3 and Table 4 about here

In reviewing Table 4, it should be noted that the final subset model included the PPVT, the transformation of the Benton-C and -D correct scores, and two variables from the Fruit Distraction Test: Card 2 time-score and Card 4 minus Card 2 error-score. These results strongly suggest that this battery is a good predictor of teacher ratings of attention deficits.

The results of the second regression in which the battery was compared to the ADDES teacher ratings--Hyperactivity Scale is shown in Table 5. These results reveal a multiple regression of .658, an associated multiple R of .432, and an adjusted multiple R of .396 ($p < .0001$), which indicates that the linear composite accounts for approximately 40% of the variance in the teacher ratings. The stepwise regression (forward entry) generated two steps, and the final subset model consisted of two variables: the Benton-C correct-score and the Fruit Distraction Test Card 2 time t-score. The standard coefficients are shown in Table 5. The composition of this regression shares similarities with the first regression and strengthens support for the proposal that a combination of these two assessment procedures may be a significant predictor of teacher ratings.

Insert Table 5 about here

General Discussion

Across both studies, the Benton proved to be an effective predictor of teacher ratings of ADHD. It is not surprising in the first study that the Benton-D raw score was a good predictor of teacher ratings and, ultimately, the attention capabilities of the subject. This tasks requires the ADHD child to allocate adequate attention to the task, ignore distractors, form a correct perceptual image, hold that image in memory, and produce a modulated motor response. As Cotugna (1987) has established, these are all very difficult challenges for the ADHD child. The only instance in which the Benton-D did not contribute significantly to the accurate prediction of teacher ratings was when the ADDES Hyperactivity Scale was used as the criterion variable.

On two of the regressions, the Benton-C correct score (subject copies a design while viewing it) also significantly contributed to the overall linear composite. In both of these regressions the standard coefficient for the Benton-C correct score was negative, indicating that as teacher ratings increased, the Benton number of correct-scores decreased. This finding is probably best explained by Cotugna's conclusion that, in general, ADHD children have difficulty in modulating their motor responses effectively.

The combination of the Benton, the CCB and the PPVT-R also proved to be a good predictor of teacher ratings. A multiple R of .774 is quite high and suggests that this combination of instruments will form a solid foundation from which to build a standard battery for the assessment of attention deficits. It is interesting to note that the Fruit Distraction Test generated both significant contributors to the linear composite. This is significantly different from the results that Cotugna found in which elements from the other CCB tests also

contributed significantly. At least for this study, the selective attention elements of the CCB appear to predict the presence of an ADHD most effectively. The influence of the Fruit Distraction Test Card 4 minus 2 error-score is easily explained by the significant influence of selective attention and the presence of a rather significant distractor (i.e., the actual color of the fruit). The other Fruit Distraction variable contributing to the composite was the Card 2 Time T score which also had a negative standard coefficient, indicating that as the teacher ratings showed less ADHD symptomology, the time on-task increased. It is believed that this result is due to the impulsivity of the ADHD child and the absence of distractors on this task.

Interesting, the Benton changed in the way that it influenced the linear composite across all three regressions. On some of the composites, the C administration contributed more significantly while on other composites, the combination of the D and C administrations was more predominant. This variability of results suggests that a global approach should be taken at this time in using the Benton in clinical practice to assist in ADHD diagnosis. More specifically, rather than take a statistical approach which favors use of a regression formula for prediction, the clinician should take a qualitative approach to interpreting the results of the Benton, realizing that some variability of results may occur depending on the setting, the client's level of attention, the presence of distractors, et cetera. This is somewhat of a moot point since the limitations of these studies suggest that development of a specific regression formula would be premature at this time.

There are several limitations in this investigation, including small sample size, limited and nonrandom sampling procedure (especially for study two), a large number of independent variables-to-subjects ratio, and the use of an exploratory stepwise multiple regression

procedure. To verify these results, additional research will be needed, using a larger sample size and a more accepted statistical procedure such as a hierarchial regression to test a specific hypotheses. The actual effectiveness of this approach cannot be validated until hypotheses testing is attempted. Also, a cross validation of the results should be made before a specific regression equation can be recommended. Finally, other assessment procedures should be examined for possible combining with the CCB and the Benton to determine if additional prediction accuracy can be obtained.

References

Benton, A.L. (1974). Revised visual retention test: Clinical and experimental applications, (4th ed.). NY: Harcourt Brace Jovanovich, Inc.

Conners, C.K. (1990). Conners' rating scales manual: Conners' teacher rating scales: Conners' parent rating scales: Instruments for use with children and adolescents. North Tonawanda, NY: Multi-Health Systems, Inc.

Cotugno, A.J. (1987). Cognitive control functioning in hyperactive and nonhyperactive learning disabled children. Journal of Learning Disabilities,20(9), 563-567.

Dunn, L.M., & Dunn, L.M. (1981). Peabody Picture Vocabulary Test-Revised. Circle Pines, MN: American Guidance Service.

Fletcher, J.M., Morris, R.D., & Francis, D.J. (1991). Methodological issues in the classification of attention-related disorders. Journal of Learning Disabilities, 24(2), 72-77.

Isaac, S., & Michael, W.B. (1983). Handbook in research and evaluation: For education and the behavioral sciences,(2nd ed.). San Diego: EdITS Publishers.

Kerasotes, D., & Walker C.E. (1983). Chapter 20, Hyperactive behavior in children, in Handbook of clinical child psychology. New York: John Wiley & Sons.

McCarney, S.B. (Ed.). (1989). The attention deficit disorders evaluation scale: School version: Technical manual. Columbia, MO: Hawthorne.

Santostefano, S. (1978). A biodevelopmental approach to clinical child psychology: Cognitive controls and cognitive control therapy. New York: John Wiley & Sons.

Santostefano, S. (1988). Cognitive control battery (CCB): Manual. Los Angeles: Western Psychological Services.

Shaywitz, S.E., & Shaywitz, B.A. (1991). Introduction to the special series on attention deficit disorder. Journal of Learning Disabilities, 24(2),68-71.

Tabachnick, B.G., & Fidell, L.S. (1989). Using multivariate statistics,(2nd ed.). New York: Harper & Row.

Taylor, H.C., & Russell,J.T. (1969). The effectiveness of tests in selection: Discussion and tables. Journal of Applied Psychology,23, 565-578.

Whalen, C.K. & Henker, B. (1991). Therapies for hyperactive children: Comparisons, combinations, and compromises. Journal of Consulting and Clinical Psychology,39(1), 126-137.

Wilkinson, L. (1990). SYSTAT:The system for statistics. Evanston, IL: SYSTAT, Inc.

Author Notes

Preparation of this paper was supported in part by a grant from the Faculty Research Fund at Southeastern Oklahoma State University to Douglas N. McMillan and Elizabeth Walters.

The authors would like to thank Hawthorne Educational Services Inc., Columbia, Missouri, for providing the Attention Deficit Disorder Evaluation Scale materials.

We gratefully acknowledge the assistance of Howard Oolila, Evelyn Toye, Deana Johnson, and Carol Wheeler for their assistance in data collection. A special thanks goes to Ann Holder for her commitment and diligence in all phases of the project.

Requests for reprint should be sent to Douglas N. McMillan, Ph.D., Southeastern Oklahoma State University, Box 4055, Durant, Oklahoma 74701-0609.

Table 1. Experiment #1. Means, standard deviations, and variance for Predictor Variables of the Benton Revised Visual Retention Test.

	ADMINISTRATION					
	A		C		D	
	Correct	Errors	Correct	Errors	Correct	Errors
Mean	3.700	11.667	6.533	4.800	2.833	13.400
Variance	5.941	44.299	8.671	31.752	5.385	38.317
Standard Deviation	2.437	6.656	2.945	5.635	2.321	6.190

Note. n=30.

Table 2. Experiment #1. Final Step of stepwise multiple regression, Conners Hyperactivity Scale (T-score)

Variable	Coefficient	Standard Error	Standard Coefficient	Tolerance
Constant	34.728	12.228	0.000	.
Age	3.631	1.509	0.424	0.847
Benton				
D-Correct	-3.438	1.129	-0.536	0.847

Note. n=30.

ANALYSIS OF VARIANCE

Source	Sum-of-Squares	DF	Mean/Square	F-Ratio
Regression	1859.043	2	929.522	5.506
Residual	4557.923	27	168.812	

Note. n=30; Multiple R=0.538; Squared Multiple R= 0.290; Adjusted Squared Multiple R=.237; Standard Error of Estimate= 12.993. $p<0.010$

Table 3. Experiment #2. Means, Standard Deviation, & Variance on Benton Revised Visual Retention Test, Cognitive Control Battery, & Peabody Picture Vocabulary Test-Revised.

	BENTON		COGNITIVE CONTROL		PEABODY
			TIME	ERRORS	
	C	D	Card 2	Card 4-Card 2	
Mean	6.943	3.057	48.324	52.118	95.912
Variance	5.820	3.291	124.044	55.440	194.871
Standard Deviation	2.413	1.814	11.137	7.446	13.960

Note. n=35.

Table 4. Experiment #2. Final Step of Stepwise Multiple Regression.

Variable	Coefficient	Error	Standard Coefficient	Standard Tolerance
Constant	176.387	24.361	0.000	.
PPVT-T	-0.403	0.168	-0.322	0.798
Benton/C-cor	-4.421	1.171	-0.617	0.536
Benton/D-cor	2.645	1.549	0.279	0.538
CCFD2T-T	-0.496	0.201	-0.316	0.871
CCFD4-2E-T	-0.640	0.292	-0.273	0.924

Note. n=34. Multiple R=0.774; Squared Multiple R=0.599; Adjusted Squared Multiple R=0.527; Standard Error of Estimate=12.021. CCFD2T-T=Cognitive Control Battery, Fruit Distraction, Card 2(T-score); CCFD4-2-T=Cognitive Control Battery, Fruit Distraction, Card 4 minus Card 2 Errors(T score).

ANALYSIS OF VARIANCE

Source	Sum-of-Squares	DF	Mean/Square	F-Ratio
Regression	6040.635	5	1208.127	8.360
Residual	4046.336	28	144.512	

Note. n=34; Multiple R=0.774; Squared Multiple R=0.599; Adjusted Squared Multiple R=0.527; Standard Error of Estimate= 12.021. $p<0.0001$

Table 5. Experiment #2. Final Step of Stepwise Multiple Regression, Attention Deficit Disorders Evaluation Scale, School Version (Hyperactivity, T-score)

Variable	Coefficient	Error	Standard Coefficient	Standard Tolerance
Constant	3.023	3.248	0.000	.
CCFD2T-T	0.165	0.056	0.425	0.889
Benton C-Correct	-0.673	0.254	-0.379	0.889

Note. n=34.

ANALYSIS OF VARIANCE

Source	Sum-of-Squares	DF	Mean/Square	F-Ratio
Regression	267.515	2	133.758	11.810
Residual	351.103	31	11.326	

Note. n=34; Multiple R=0.658; Squared Multiple R=0.432; Adjusted Squared Multiple R=0.396; Standard Error of Estimate=3.365, $p<0.0001$.